Advances in Cardiac Research

CASE REPORT

Balloon Pulmonary Angioplasty: An Effective Treatment for Chronic Thromboembolic Pulmonary Hypertension?

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Abstract

Chronic thromboembolic pulmonary hypertension (CTEPH) is a precapillary form of pulmonary hypertension resulting from complications of pulmonary emboli arising from venous thrombosis, leading to pulmonary artery stenosis or obstruction and subsequent right heart failure. Management options for CTEPH include medical therapy, operative therapy, and intervention therapy. In cases where patients are deemed unsuitable candidates for pulmonary endarterectomy (PEA), alternative interventions such as balloon pulmonary angioplasty (BPA) can be considered. To confirm the diagnosis and assess the suitability for BPA, additional examinations including pulmonary angiography, computed tomography pulmonary angiography, magnetic resonance imaging, and right heart catheterization were performed. Current guidelines recommend that BPA should only be conducted in experienced CTEPH expert centers where concurrent medical therapy can be initiated.

Herein, we present a case of a patient who underwent BPA due to the presence of thrombus in the main pulmonary artery and segmental and distal pulmonary arteries, contraindicating PEA. The patient demonstrated significant improvements in clinical outcomes, as evidenced by improved results in the 6-minute walk test, along with echocardiography and computed tomography pulmonary angiography findings post-BPA. Our experience with this patient highlights the potential of BPA as a viable treatment option for inoperable CTEPH patients, resulting in favorable clinical status and improved hemodynamics, with a low mortality rate. This case demonstrates the successful application of BPA in achieving stability and symptom alleviation compared to the pre-procedural state.

Keywords: *Chronic thromboembolic pulmonary hypertension, Pulmonary endarterectomy, Balloon pulmonary angioplasty.*

Introduction

Pre-capillary pulmonary hypertension is defined by mean pulmonary arterial pressure (mPAP) > 20mmHg, pulmonary arterial wedge pressure (PAWP) ⩽15 mmHg, and pulmonary vascular resistance (PVR) > 2WU (Wood Units). Chronic thromboembolic pulmonary hypertension (CTEPH) is a form of precapillary pulmonary hypertension caused by complications of pulmonary emboli arising from sites of venous thrombosis caused by pulmonary artery stenosis or obstruction that leads to right heart failure and death.[1-3] Therapeutic options for patients with CTEPH consist of 3 parts; operative therapy, interventional therapy, and medical therapy. Pulmonary endarterectomy (PEA) has immediate effects with low perioperative mortality risk and satisfactory prognosis for patients with proximal lesions. [2-5] Interventional therapy is also a promising alternative operative treatment for patients with CTEPH, with the development of catheter based interventional therapy namely, balloon pulmonary angioplasty (BPA). [6-8]

Here, we report a case of a 50-year-old female with CTEPH who successfully underwent the BPA procedure.

Case Presentation

A 50-year-old female presented to the emergency room with sudden weakness for the last 2 days. She also complained shortness of breath which worsened over the last 5 days. The patient had no prior medical history of heart disease, pulmonary disease or deep vein thrombosis (DVT), hypertension, stroke, or diabetes mellitus, and no family history of similar complaints. The patient was a physiotherapist, usually serving patients at their home so she was often moving around. The patient had a history of flying for six hours by plane in 2018. On admission, the patient's vital signs were normal. Chest examination showed bilateral rhonchi, without wheezing. No swelling or signs of varicose veins or DVT on both legs. During the 6-minute walking test (6MWT), the patient was able to walk 300 meters. Chest X-ray showed cardiomegaly and a 'reversed coma sign' which was suggestive of pulmonary hypertension that might be due to CTEPH. Echocardiographic examination showed normal left ventricular ejection fraction (LVEF) of 65%, global normokinetic at rest, dilated right atrium (RA) and right ventricle (RV), severe tricuspid regurgitation (TR), and high probability of pulmonary hypertension (PH). There was no LV systolic dysfunction and no regional wall motion abnormalities (RWMA).

The 2D computed tomography (CT) pulmonary angiography (CTPA) revealed the presence of an intraluminal thrombus in multiple locations, including the bilateral main pulmonary artery, right upper lobe (RUL) anterior artery (segment 3), right inferior lobar artery, right lower lobe (RLL) anterior basal artery (segment 8), RLL posterior basal artery (segment 10), left inferior lobar artery, lingular artery, and left upper lobe (LUL) anterior segmental artery (segment 3). Secondary signs observed in the imaging included the widening of the pulmonary trunk, mosaic attenuation in both lung fields, fibrosis in the posterior segment of the right superior lobe, and a slightly enlarged right ventricle with thickened walls. These findings strongly supported the diagnosis of suspected pulmonary embolism in the context of CTEPH.

BPA was performed twice, followed by CTPA after each BPA. At first, selective pulmonary lobe angiography was performed in anterior-posterior and lateral projections depicting in detail the lesions identified in the baseline angiogram. Pulmonary angiography showed a thrombus at the mid-distal part of right pulmonary artery. Ballooning was performed in the right pulmonary artery. Alteplase 20 mg and heparin 4000 IU was administered to the right and left pulmonary artery 5 minutes before the BPA procedure. Initial dilatation was performed with a balloon (Armada; 5.0 mm x 60 mm) to reach the 14 atm from mid-distal right to left pulmonary artery until full balloon expansion. After the procedure, the pulmonary arterial flow was completely restored, and injected contrast showed TIMI flow 3, residual hazy thrombus less than 30% at the distal right pulmonary artery with no signs of arterial rupture or wire injury. Oxygen desaturation did not exceed 4% and hemoptysis did not develop throughout the procedure. After the procedure, rivaroxaban 15 mg twice daily was added to the therapy. The patient underwent hospitalization for a total of 4 days before being discharged. All CTPA images before and after BPA were shown in Figure 1.

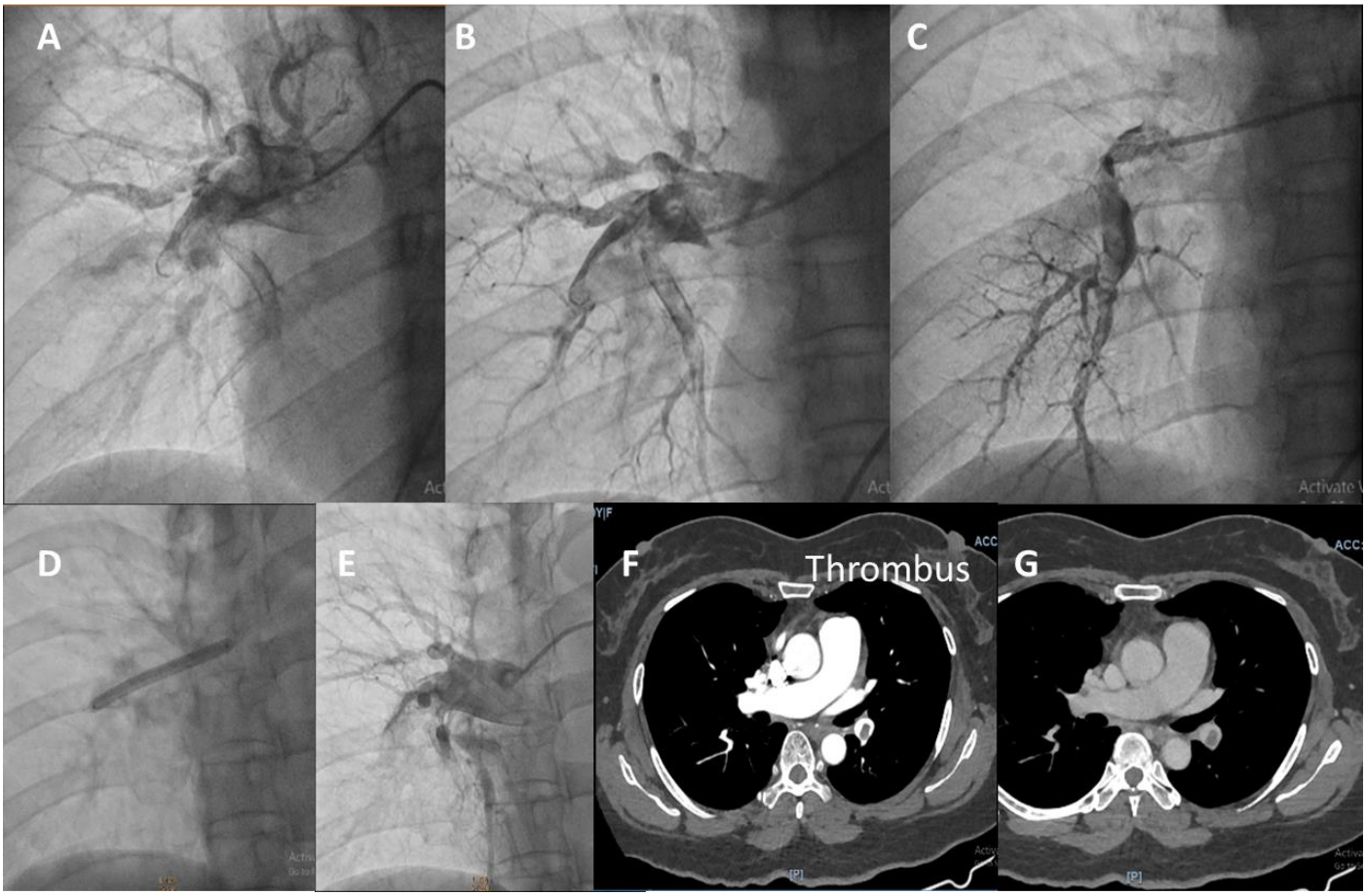

Figure 1. Pulmonary angiography view before BPA procedure (A.) LAO-Caudal View, (B.) (C.) RAO-Cranial view. Pulmonary angiography view after BPA procedure in the right pulmonary artery. (D.) BPA in right pulmonary artery (E.) RAO-Cranial view. CTPA view suggestive of CTEPH after first BPA procedure. (F.) Axial view with contrast media, (G.) Axial view without contrast media.

Two months after the first procedure, the patient underwent another procedure of BPA for the lesion located in the left pulmonary artery. After the intervention, CTPA re-evaluation showed intraluminal thrombus in the main pulmonary artery bilaterally, RUL anterior segmental artery 3, right inferior lobar artery, RLL anterior basal artery 8, RLL posterior basal artery 10, still fixed, and some are left in the arterial wall. Significant contrast flow smooth to distal, as evidenced by no visible lesion in the peripheral parenchyma right lung. The same thrombus (pulmonary embolism) was still visible in the left inferior lobar artery, lingular artery, LUL anterior segmental artery 3, the contrast flow was still distal, as evidenced by the absence of visible infarct lesions in the peripheral parenchyma of the left lung.

Three months after the second BPA procedure, echocardiography was performed. The results showed normal heart chambers, global normokinetic wall motions at rest, normal LV systolic function, normal RV contractility, no valve incompetence (no TR), and no probability of PH. We also re-tested the patient with 6MWT, and the patient was able to walk 500 meters. All CTPA images before and after BPA were shown in Figure 2.

Discussion

According to the 2022 guidelines for the diagnosis and treatment of pulmonary hypertension published by the European Society of Cardiology and the European Respiratory Society (ESC/ERS), PEA is the treatment of choice for CTEPH.[1]

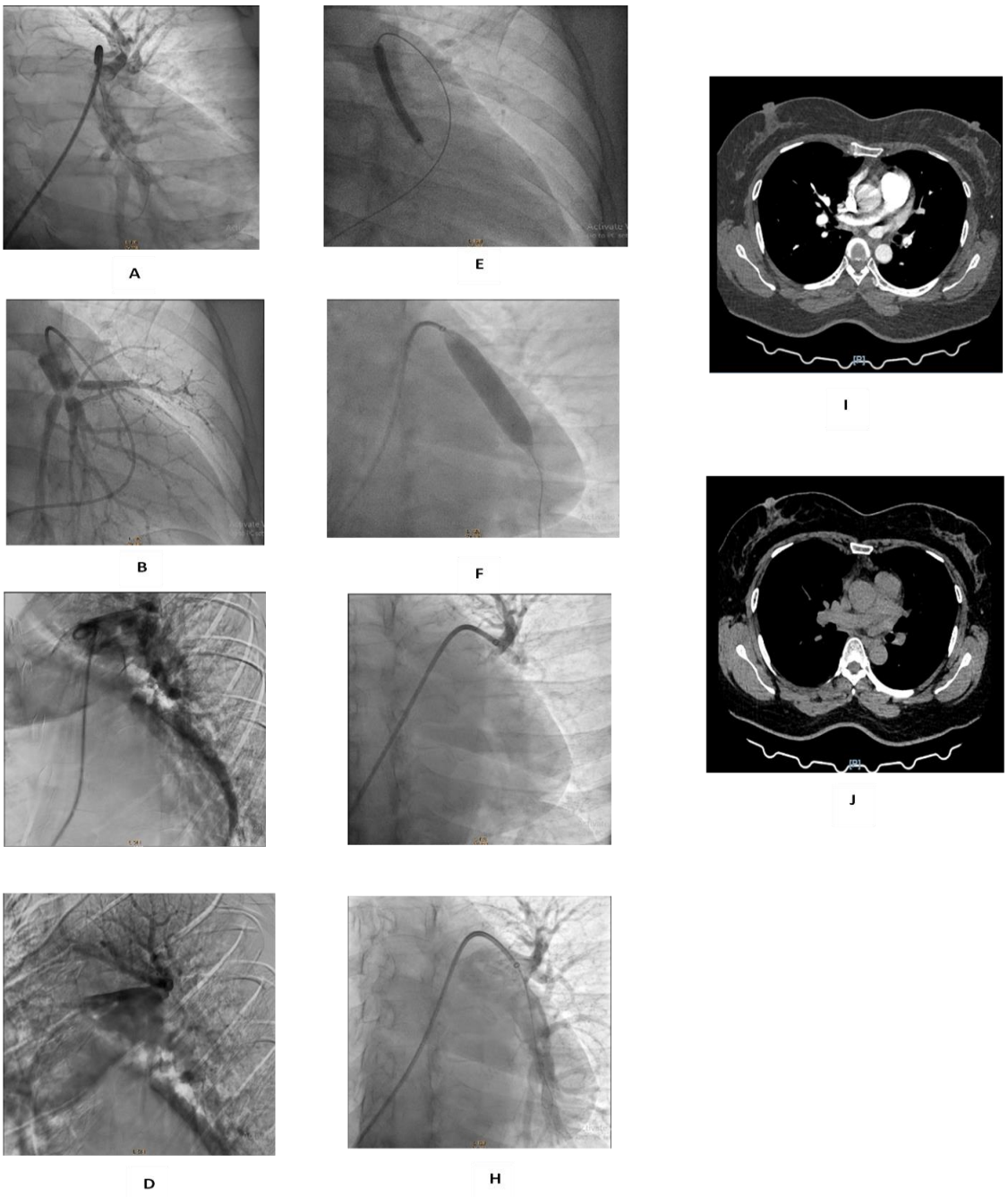

Figure 2. CTPA before BPA procedure in left pulmonary artery (A.) RAO-Cranial view, (B.) RAO-Caudal view. Digital Subtraction Pulmonary Angiography before BPA procedure in left pulmonary artery (C.) RAO-Cranial view, (D.) RAO-Caudal view. CTPA view after BPA procedure in right pulmonary artery. (E, F) BPA in left pulmonary artery (G.) RAO-Cranial view. (H.) RAO-Caudal view. CTPA view suggestive of CTEPH after secondary BPA procedure. (I.) Axial View with Contrast, (J.) Axial View without contrast.

The operability of patients with CTEPH is determined by multiple factors that cannot easily be standardized. These are related to the suitability of the patient, the expertise of the surgical team, and available resources. General criteria include pre-operative New York Heart Association (NYHA) functional class and the surgical accessibility of thrombi in the main, lobar, or segmental pulmonary arteries.[1,9] BPA has been accepted as a therapeutic strategy.[1] Since then, several studies focusing on the successful use of balloon angioplasty in peripheral pulmonary stenosis were reported.[1,6,7,8,10] After years of unremitting efforts, ESC/ERS guidelines recommended that BPA should only be considered in an

experienced CTEPH center where medical therapy could be concurrently initiated. In this patient, BPA was performed because CTPA showed thrombus in the main pulmonary artery and some thrombus in the segmental and distal pulmonary arteries which was one of the contraindications of PEA. From this patient, we got a good outcome, starting from an improvement from the 6MWT examination, accompanied by an improvement in the results of echocardiography and CT pulmonary angiography after BPA was performed.

Conclusion

By conducting the BPA procedure on this patient, we can enhance the clinical condition and hemodynamics of individuals with CTEPH who are ineligible for surgery, while keeping the mortality rate low. In this specific case, BPA was performed due to the presence of thrombi in the main pulmonary artery, as well as in segmental and distal areas beyond the pulmonary artery, which posed a contraindication to PEA. Following the procedure, the patient achieved stability and became symptom-free compared to their pre-procedure state, indicating a favorable outcome.

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Conflicts of interest

The authors have no conflicts of interest to declare.

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